Decentralized control with communication and computation constraints

Commande décentralisée avec contraintes de communication et de calcul

Keywords: Multi-agent systems, control theory, constrained control systems, communication

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PhD thesis in collaboration with CEA-List / Communicating Systems Laboratory.
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This PhD thesis will be developed in the framework of ”Projet de Ressourcement en Région Lorraine” and will be supervised by Marc Jungers, Irinel-Constantin Morărescu from CRAN and Christophe Janneteau and Michael Boc from CEA LIST.

1 Scientific context

Embedded systems have become a predominant component of modern engineering systems. An important application domain of embedded technology is the field of control systems where embedded software is executed in order to control a physical plant. The software receives information about the plant, processes this information and determines control actions that are applied to the plant. Moreover, these systems are often interconnected with others forming a network. A typical application of such networked embedded systems is the decentralized control of fleets of robots.

Figure 1: Each system compute its control action using information received through a time-varying interaction graph from its neighbors.
2 Objectives

Traditionally, the design of embedded control systems assumes a separation of concerns between computation and control. An integrated approach where the constraints due to limited or shared computational resources are taken into account in the synthesis of control strategies would enable the development of high quality embedded controllers with guarantees of safety, stability and performance, while optimizing the usage of the available computational resources.

The main objective of this thesis is to design decentralized controllers that integrate the communication and computation constraints. In other words, we specify the computation budget and the communication bandwidth and range and we want to design a controller that can be executed under these constraints. In order to satisfy the communication constraints we will impose a limited number of simultaneous communications per agent. The computation constraints will be taken into account by designing simple control laws that require small computation loads. This will be basically done by decoupling the controller in two parts. The first will compute reference trajectories based on standard consensus algorithms while the second will design tracking controllers for each agent independently from the others.

Moreover, these results will be illustrated both in simulations and on a specific platform that has to be designed for this goal. A part of this PhD will be dedicated to build this experimental platform composed of a fleet of robots.

3 Background of the candidate and contact

We are looking for a candidate with a MS or engineer degree having a good background in control theory. The applicant should be interested in theoretical and practical aspects of multi-agent systems. The working language can be either English or French. The standard duration of a PhD thesis in France is 36 months and the net salary is around 1 600 euros. Applications have to be sent by email at: marc.jungers@univ-lorraine.fr, constantin.morarescu@univ-lorraine.fr. They can also be contacted for further information, and should include a resume, recommendation letters (or persons to contact preferably).

The position is open and the candidate can start anytime but not later than 01/10/2016.

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References


